Missouri River Main Stem
Current Drought Operations

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BASIN HISTORY

The Missouri River Basin includes 529,000 square miles, roughly 1/6th of the United States and comprises portions of 9 states and all of the state of Nebraska, as shown in Figure 1. The Missouri River Main Stem System (System) is the largest reservoir system in the United States in terms of total reservoir storage. The System is composed of only six projects; Fort Peck in Montana, Garrison in North Dakota and Oahe, Big Bend, Ft. Randall and Gavins Point in South Dakota. Garrison, Oahe and Fort Peck are the 3rd, 4th and 5th largest reservoirs in the United States and make-up 88 percent of the total storage in the System. Even Fort Randall is a relatively large Corps project as shown in Figure 2. Figure 2 shows the relative storage in Corps reservoirs in the United States. Only the reservoirs formed by Glen Canyon and Hoover dams (USBR projects) on the Colorado River are larger than the three big Missouri River dams.

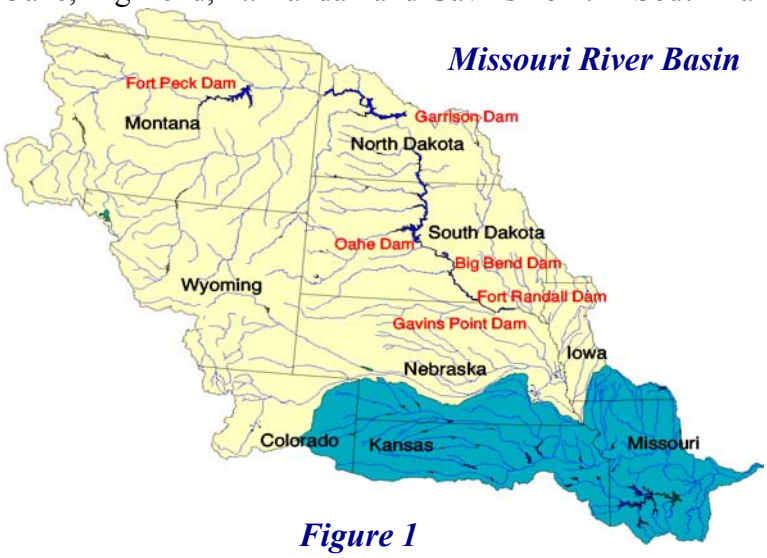


Figure 1

Fort Peck dam was constructed in 1933 during The Great Depression as a WPA project to put people to work. Fort Peck's purpose was to serve navigation on the Missouri and Mississippi rivers with hydroelectric power production authorized 5 years later. Fort Peck is the largest hydraulic fill dam in the world. The USBR and Corps developed water resource plans for the Missouri River basin. Congress directed the USBR and Corps to unify their separate plans for the Missouri River basin into

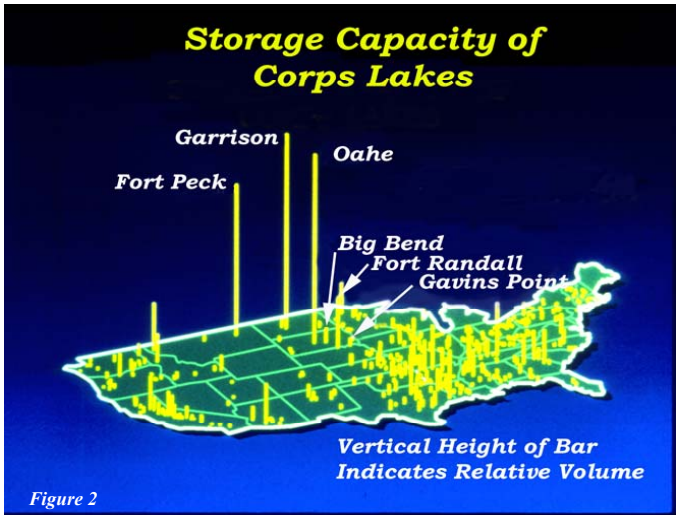
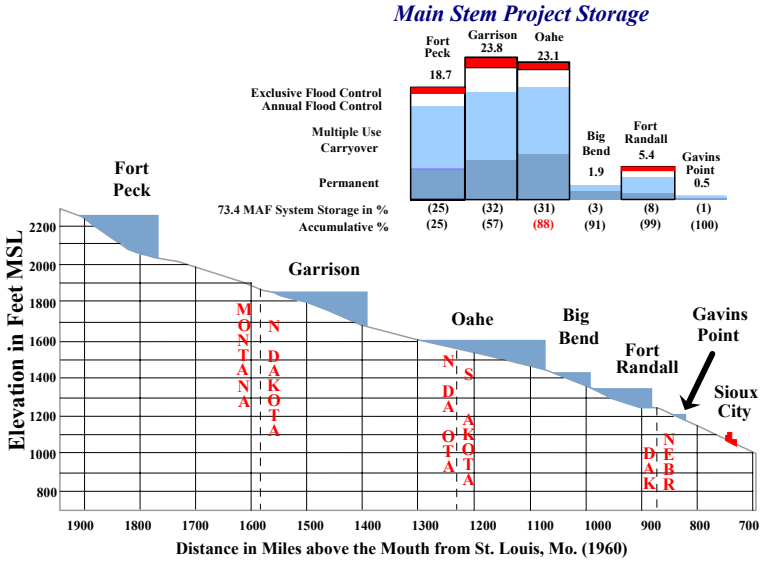


Figure 2

one plan. The unified plan was called the Pick-Sloan Plan. Congress, in the 1944 Flood Control Act, approved this plan. The resulting plan cited "dam construction to utilize the water resources for present and ultimate requirements of flood control, irrigation, navigation, hydroelectric and other uses". An amendment to the Flood Control Act established priorities. It gave beneficial consumptive uses priority over navigation. Fort Peck which was already constructed was incorporated into this encompassing basin plan.

Construction of the remaining five dams began in 1946. The time to construct each project varied from 5 to 14 years, with the two large upstream projects requiring the longer time. When completed Garrison and Oahe became the 4th and 10th largest earth-fill dams respectively in the world. The second most significant drought in the past century in the Missouri River basin occurred during and immediately following the construction of the System. The drought began in 1954 just after Fort Randall and Garrison were closed, it and extended for 8 years until the year before the last main stem project, Big Bend was closed in 1963. Seventy-five million acre-feet of storage were available for multipurpose use when the System was completed, the largest such system in the United States. This System held 3 years of the annual flow of the Missouri River at Sioux City, Iowa, which is located just downstream of the System. It was not until the summer of 1967 that the carryover storage zone was filled. The System was considered operational as a system in 1967.



Profile of Missouri River Main Stem Reservoir System
Figure 3

The System is multipurpose, but certain projects are better adapted to fulfill certain authorized purposes better than others. The upper three reservoirs are fully multipurpose and have the lion's share of the storage for ensuring service to navigation, hydropower production, fish and wildlife enhancement, water quality and water supply during drought periods as shown in Figure 3. They also contain the greatest flood control storage capacity. All of the dams generate hydropower; however only at Big Bend and Oahe can the full peaking capability of the hydropower be utilized year round without other constraints. These two serve as swing plants that fully adjust the System hydropower to the hourly and daily fluctuations in electrical load.

The three downstream reservoirs, Big Bend, Fort Randall and Gavins Point are small by System standards. However, they can be operated at normal levels even during an extended drought. This is very important to certain authorized project purposes such

as; recreation, fish and wildlife enhancement and irrigation. Fort Randall operation involves a unique "fall draw down" to create a large amount of storage space just prior to the onset of extremely cold winter temperatures. This space is filled by releasing more water than is needed for winter requirements below the System. The higher releases from Fort Peck, Garrison, Oahe and Big Bend produce additional low cost winter energy that is needed in the basin states for winter heating. This extra water is slowly captured in the empty space at Fort Randall in a "winter fill" operation during December through February. This operation not only provides the extra energy needed but also provides water conservation by just moving the water lower in the System and not releasing it from the System. Also flood control is better served by having a lower winter release in the river reach below the System because it is subject to ice-jam flooding. The flood plain area below the System contains the majority of the higher population urban centers that would incur significant flood damages if a downstream ice-jam flood were to occur.

The System projects each have four distinct operational zones. A Permanent Pool Zone is the lowest zone and provides a storage pool adequate to provide minimum head for power generation and an area for sediment storage. Next a Carryover Multiple Use Zone is provided to support the many project purposes that require water during an extended drought. An Annual Flood Control and Multiple-Use Zone is available to store the seasonal flood run-off that is evacuated during the non-flood season. Finally the upper zone is designated as the Exclusive Flood Control Zone that is available to store surplus runoff during very large runoffs. Figure 4 indicates the current size of the zones if all six projects were just one very large project.

Missouri River Main Stem System
Storage Allocations

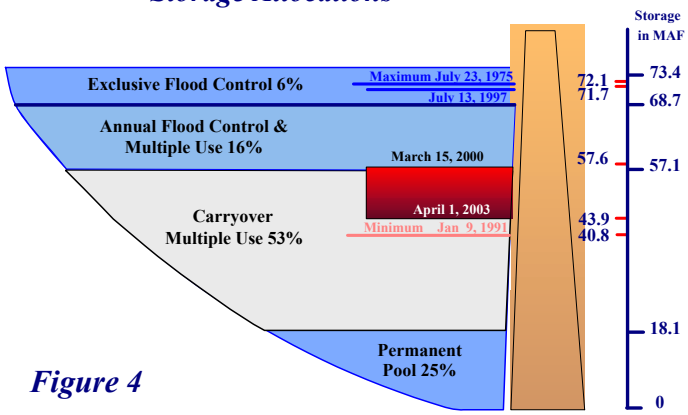


Figure 4

Total Storage = 73.4 MAF

REGULATION OF MAIN STEM SYSTEM FLOOD CONTROL REGULATION

This paper focuses on the more controversial water conservation regulation during drought; however, a discussion of the flood control capabilities of the System also seems appropriate. The effectiveness of the System to prevent significant flood damages is shown in Figure 5. This one purpose has more than paid for the construction of the whole System. Still floods occur downstream of the System, mainly because 47 percent of the drainage area in the basin lies below the System, where higher annual rainfalls and associated runoffs generally occur.

Missouri River Main Stem Reservoirs Flood Damages Prevented Indexed to 2001

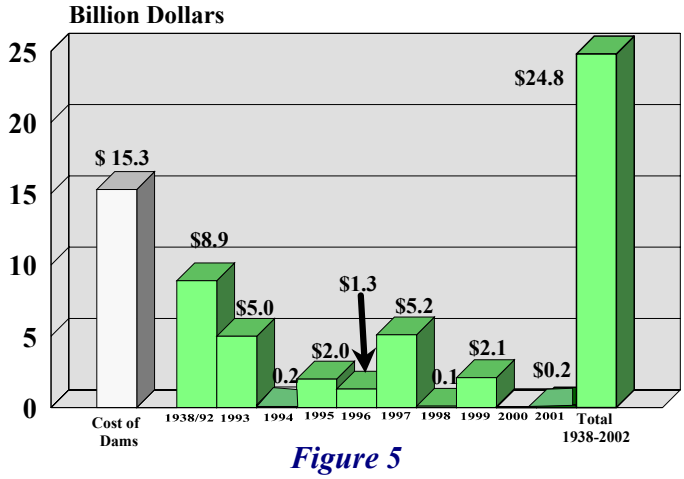


Figure 5

The System regulation during significant basin floods involves coordination with the Kansas City and Omaha Corps Districts for tributary Corp dam projects and Bureau of Reclamation (USBR) dam projects with authorized flood control storage because many projects are releasing into the same downstream channel area. The Reservoir Control Center (RCC) has the responsibility for coordinating the Missouri River basin flood control operations with the districts and USBR and directs their operation in order to obtain the best overall flood benefit for the basin.

The flood waters are evacuated by computing a service level that takes into account; the volume of water currently in the System, the forecasted runoff volume that will enter the System prior to the next runoff season, the remaining time period available before the next flood season, a lower System winter release requirement because of ice cover with the potential for ice jams, and the amount of water in major tributary reservoirs that will be passed to the System prior to the next runoff season. This procedure is documented in the System Master Manual on Plate 44, a copy of which is available on the NWD-MR website. The System has four downstream target locations; Sioux City, Iowa; Omaha, Nebraska; Nebraska City, Nebraska; and Kansas City, Missouri. Water is then released at the calculated service level to meet downstream targets. Flood control is accomplished by placing limits on exceeding this service level at the target locations. When these limits are forecasted to be exceeded, the System release is reduced until the downstream runoff subsides, then System release is again increased. If downstream flooding reduces releases for a long period of time, a new service level is calculated that is higher which sets the base flow higher and raises the amount of water that can be released. The flood control limits do not change, only the service level.

The service level is normally only calculated once monthly when a new monthly forecast is completed, however, during significant flood events it is recalculated when required, sometimes on a weekly basis. The intra-System regulation is accomplished both through a Daily Routing Model Study normally conducted on a monthly basis and each week a 3-week forecast is run to fine tune water movement among the projects. No matter what volume of water is captured by the System, the goal is to have any surplus water evacuated prior to the next runoff season, which begins on March 1. Some controversy develops during significant System flood control regulation. The shorter time period to return to normal reservoir levels and lack of alternative regulation options minimizes controversy. Most opposition involves agricultural interests located in the

flood plain close to the river who cannot obtain adequate drainage from their fields because of the high river levels. Seepage through the levees and high ground water levels often cause additional loss of agricultural crops. High river flows can also close the river to navigation or prevent the loading of barges. The Missouri River was closed to navigation for 57 days during the1993 flood event. The years of 1967, 1975, 1978, 1993 and 1997 were the most challenging flood operation years. Two of the years, 1975 and 1997, resulted in the System storage entering the Exclusive Flood Control Zone. Two other years, 1978 and 1993, followed significant drought periods that had reduced System storage prior to their runoff or these years also would have had System storage enter the Exclusive Flood Control Zone. The years of 1978 and 1997 had significantly above-normal plains and mountain snowfalls while 1975 and 1993 were the result of rainfall events. All large runoff years taxed the System. The flood control plan performed well. Small changes have been made to fine tune the system for future events.

WATER CONSERVATION REGULATION

There is no question that the operation during drought is the most challenging period to regulate the Main Stem System. More authorized purposes are affected during significant drought, and the negative impacts are generally less localized. Drought and the associated water conservation regulation can drag on for years at a time, which tends to compound and amplify criticism. A look at the period of record from 1898 to present of runoff above Sioux City, Iowa (whose location approximates System inflow) during the period indicates significant drought is somewhat rare. Drought for this purpose is described as a period of 3 or more consecutive years with less than average runoff as shown in yellow Figure 6. The annual runoff is shown in million acre feet (MAF) with a vertical bar for each year. The System was filled in 1967, but three out of four droughts in the historic record have impacted the System operations. The very first drought was used to develop the System water conservation regulation criteria. Also shown in this Figure 6 are the range of forecasted runoff used to bracket the potential for varying runoff in the basin. The Median forecast represents 24.6 MAF of runoff in a normal runoff year with half the runoffs in the period of record being higher and half being lower. Also Upper and Lower Decile forecasts are run, and under normal median

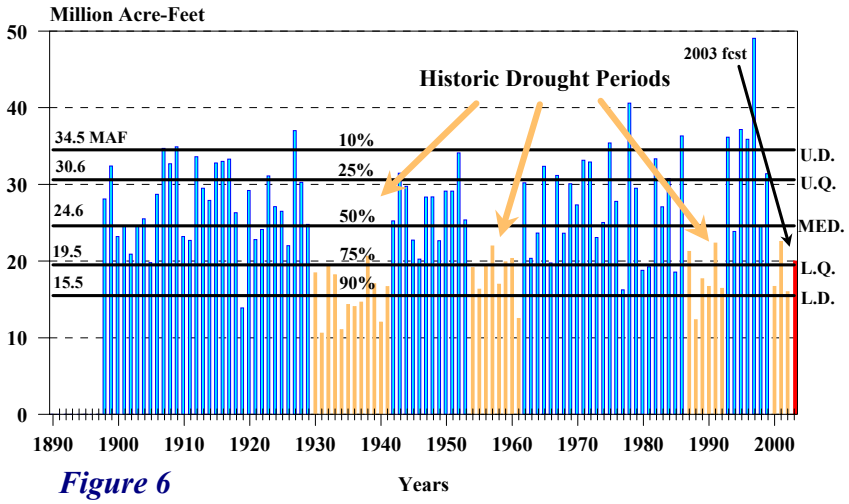


Figure 6

runoff conditions they represent 34.5 MAF and 15.5 MAF, respectively. These forecasts bracket 80 percent of the historic runoff with a 10 percent chance runoff could be higher or lower. This provides a range of runoffs that can be used for planning the various activities that revolve around the authorized project purposes. Forecasts are run on a monthly basis. When the Most Likely forecast is more or less than Median runoff, the Upper and Lower Decile forecast runoffs are adjusted. As an example, this year with a 1 April 2003 Most Likely forecast of 20 MAF, the Upper Decile is 26.0 MAF and the Lower Decile is 14.9 MAF of runoff.

The original crafters of the System water control plan knew the effects the 12-year drought of the 30's had on the basin. Many farmers and businessmen left the basin in ruin never to return. The serving of all authorized purposes during a similar drought was a primary consideration in the planning and construction of the System. The System regulation during drought was integrated into the current water control plan.

There are four areas that deal with drought in the current System water control plan. The Carry Over Multiple Use Zone is very large compared to other storage zones and reservoir systems in the United States. The three upstream projects have the majority of this storage (88%), which is filled during times of abundant water supply in the basin and then metered out during the dry years. The Carry-Over Multiple Use Zone has 39 MAF that is a supplement to the actual annual runoff that occurs during major drought. In addition, the following criteria (shown in Figure 7) apply to drought:

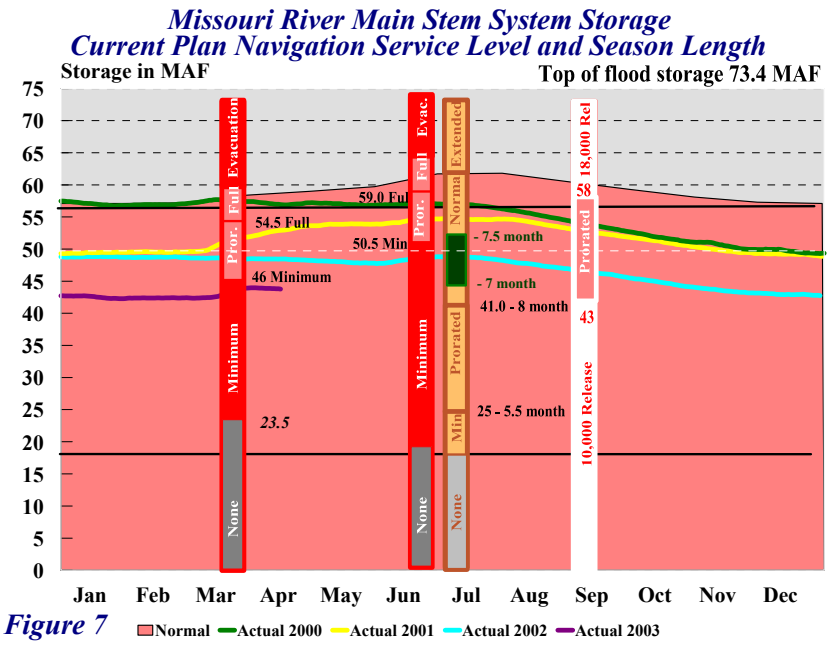


Figure 7

1. **Winter System releases** are reduced according to a System water-in-storage check conducted on 1 September. At a System storage of 58 MAF or more System release is 18,000 cfs or higher, at 58 MAF to 43 MAF it is prorated between 18,000 and 10,000 cfs release, and at less than 43 MAF it is10,000 cfs. The savings during the 90-day winter period is basically (18,000 - 10,000 cfs) 8,000 cfs per day for 90 days, or 1.4 MAF. The lowest the System release rate has been recently is 12,500 cfs because of problems at downstream intakes used for powerplant cooling and municipal water supply. Most constraints are the result of channel degradation in certain reaches of the Missouri River. The two locations where most of the problems occur are the Sioux

City and Kansas City reaches that have experienced the most severe degradation. Also another significant winter factor is ice formation that results in reduced downstream flow.

2. **System Service Level** is reduced according to two annual System water-in-storage checks. The checks are performed on 15 March for the beginning of downstream flow support, which starts on 1 April, and System storage is again checked on 1 July for the remainder of the season that normally ends on 1 December. The service level varies from full to minimum service by a 6,000-cfs System release rate on a prorated basis on 15 March System water-in-storage check for a storage range between 54.5 MAF and 46 MAF. Full service provides for channel depth of 9 feet and minimum service provides for a channel depth of 8 feet. Also if the System storage is less than 23.5 MAF on 15 March no season is provided. The service level also, varies from full to minimum service by a 6,000-cfs System release range on a prorated basis on 1 July water-in-storage check for a storage range between 59 MAF and 50.5 MAF. If the System water-in-storage is less than 18 MAF no season is provided. The water conservation varies from zero to a 2.9 MAF maximum from providing full to minimum service for a whole downstream support season from 1 April to 1 December.

3. **Length of season** is also reduced according to a System water-in-storage check**.** The season length check is conducted on 1 July. The season length is a full 8-month season if System storage is above 41 MAF. The season length is prorated from 8 to 5.5-months if System storage is in the range from 41 MAF to 25 MAF. If System storage is below 18 MAF no season is provided. The water saved varies from zero to a 2.1 MAF maximum from providing a normal 8 month season to a 5.5 month long season.

4. **System Water Accounting** is a procedure used to correct for any variance that has occurred in implementing the current water control plan criteria to meet the operational objectives stated in the current master manual. This allows for changes that have occurred since the current plan was developed. The two major changes are; a System release of 10,000 cfs in the winter does not meet the downstream water supply purpose as originally envisioned and the Endangered Species Act Law requiring Federal operation for endangered species nesting, which can use more water during summer than the current plan calls for. To adjust for these extra uses of Carry Over Multiple Use storage, the extra water used for winter release, endangered species, and any other purpose is determined on 1 March and an adjustment is made to the service level or season length the following season to get back to the correct volume of water used for conservation.

MAIN STEM WATER CONSERVATION REGULATION
Drought 1987 - 1992

The System water control plan was in place prior to the 1987-1992 drought but not fully tested. Since the system had filled in 1967, a significant drought had not occurred. Of course, while most of the system was being constructed and attempting to be filled, the 1954-1961 drought delayed everything. The current System criteria delays making significant water conservation early in a drought but then compensates when

coming out of a drought by returning back to normal slowly. Also, all water conservation changes are based on actual water-in-storage, not forecasted data. Few contemplated how significant changes to the authorized purposes would occur in such a short period of time. The 1987-1992 drought event and the System operation will be discussed followed by the affects on the various authorized purposes. The following table summarizes the System operations during the 1987-1992 drought.

System Significant Criteria during Drought 1987-1992

Year	Calendar Year Runoff-MAF	15 March Storage MAF	Level of Service Kcfs	1 July Storage MAF	Level of Service Kcfs	1 Sep Storage MAF	Winter Release Kcfs	LengthNav Season Months
1987	23.1	59.4	full	62.9	full	60.9	18.0	8.0
1988	12.4	55.8	full	54.3	full	50.5	12.5	7.5
1989	17.7	45.3	-3.0	47.8	-3.0	45.3	10.5	6.9*
1990	16.7	44.3	-6.0	45.2	-6.0	43.9	9.0	6.9*
1991	22.3	41.7	-6.0	47.7	-6.0	46.8	12.0	6.9*
1992	16.4	45.4	-6.0	45.1	-6.0	44.7	12.0	6.9

* Season shortened one week at beginning of season in March

1987 – Downstream flow support provided at full service level with a normal season length. First year of drought so no conservation occurred. Winter release was normal.

1988 – Runoff was very low, 12.4 MAF. Downstream flow support started on normal season opening dates at full service. The navigation season was shortened 3 weeks in the fall and 1 week the following spring based on adjusted manual criteria. The one-week adjustment in the spring of 1989 was because a higher service level was provided in 1988 than the System criteria indicated. Winter System releases were schedule at 12,500 cfs when the navigation season closed in November.

1989 – Downstream flow support began 1 week later than normal to make up for the higher service level provided in 1988. The 1989 service level was reduced to 3,000 cfs below full service. The navigation season closed 4 weeks early based on adjusted manual criteria. The 1 July system storage was 47.8 MAF. Based current System criteria, any storage which was less than the 50.5 MAF required minimum service flow support (6,000 cfs reduction) for the remainder of the 1989 season. After meeting with the basin interests, a rate of 3,000 cfs less than full service was provided in exchange for a reduced season length. The navigation season was, therefore, closed 4 weeks early to balance the higher flows provided during the season. In September, there was discussion of lowering the service level to –5,000 cfs and a round of meetings occurred but the service level was left at –3,000 cfs and the season was shortened to balance the extra water used. Fall releases were reduced to 10,000 cfs but intake problems occurred. System winter releases were determined to be 10,500 cfs based on the System water-in-storage check. Four hundred miles of ice cover on the Missouri River existed during the coldest winter period. By mid-January releases were lowered to 10,500 cfs. In March releases were reduced to 9,500 cfs after coordinating with users, which had experienced intake problems along the river.

1990 - Flow support again began 1 week later than normal as an added conservation measure from the 1989 season and at minimum service based on 15 March System water-in-storage check and another 4 weeks was shortened on the season length in the fall. A lot of specific interests provided input to System release rates and downstream target values during the draft 1990 AOP period during the fall of 1989. A proposal was made by Division staff to HQUSACE that the 1990 season, start 1 week late for water conservation not taken in 1989, provide minimum service flows as required by the manual and that the season close 2 weeks early. This was the first year flows were at minimum service. HQUSACE opted to close the 1990 season 4 weeks early, which went beyond the technical criteria of the manual and any water accounting for water used during other periods of the year. The Missouri River navigation season closed on 1 November. System release was reduced to 9,000 cfs by 14 November. Releases were increased to 16,000 cfs in mid-December for winter ice-in. A series of ice jams formed and river levels dropped considerably and many intakes lost suction for over a day, as the stage reduction moved downstream. Winter releases were as low as 9,000 cfs after the ice cover stabilized in February. One hundred seventy-six miles of ice cover formed on the Missouri River during the winter of 1990-1991.

1991-After several meetings during the fall of 1990, the Division Commander determined additional water conservation measures more than indicated in the manual were required. The commander determined the season length would be the same as 1989 and 1990 or 5 weeks shorter than normal and the service level would be at minimum service. Tows were again loaded to 7.5-foot drafts. The tow "Tara Ann" sunk on 26 July 26 1991 after a grounding. The navigation season closed on 1 November. Once ice cover formed, System winter release varied between 12,000 and 14,000 cfs. During February, releases were first reduced to 9,000 cfs and then were further reduced to 6,000 cfs. Releases were at 7,000 cfs prior to the come up for the 1992 navigation season. Tributary flows provided additional support so downstream intakes functioned.

1992 -There were several meetings to discuss the 1992 downstream flow support. The season opening date was the normal date of 1 April at the mouth. Flow support was at the minimum service level. It was determined the closing date would be based on the 1 July System water-in-storage check. The navigation season was closed 1 month early.

1993 - The season started at minimum service flows and on the normal opening date of 1 April. Because of high downstream and upstream runoff the System storage recovered to normal levels during 1993 and essentially the System refilled. The navigation season was closed 7 weeks during the summer of 1993 due to extremely high downstream flows and the overtopping of many levees along the Missouri River due to the Great Flood of 1993.

SUMMARY – Even though a drought plan was in place, authorized purpose expectations had significantly changed. Federal irrigation was never developed. This upstream benefit was essentially replaced by higher than envisioned recreation at the lakes, which was a non-consumptive use so it had to compete for priority with the other purposes. Successful recreation required good reservoir access and high pool levels,

which was difficult to accomplish in a drought situation. The upstream reservoirs were not well prepared for the drought that occurred in the late eighties. Boat ramps were soon out of water with no funding available to extend them to meet the falling lake levels. Many recreation areas on the reservoirs were closed. Private irrigators could not reach the water or had insufficient pumps to move the water due to the additional head they had to pump against. In the third year of the drought, the Corps obtained $3 million dollars in Federal funding and many of the recreation areas had boat ramps either built at a lower level or extended to improve lake recreation access. However, the political pressure to reduce downstream flow support somewhat succeeded, when the decision was made to reduce the season length more than the criteria in the manual required. Also it was felt that a water control plan update was needed to support the contemporary needs of the basin. The study for a revised water control plan was initiated in1989 and still has not been completed, although it is nearing another decision point. System winter release to meet downstream water supply was higher than envisioned because of accelerated degradation. Operations for endangered bird species nesting resulted in considerably higher flows during the summer that were never envisioned. The System Master Manual was developed in 1960 and revised in 1975 and 1979, and operations for threatened and endangered birds did not occur until 1986. Lawsuits resulted because of the deviation from the manual during this, the first drought to occur since the system filled in 1967

MAIN STEM WATER CONSERVATION REGULATION
Drought 2000 – Present

One would have expected a new water control plan to have been implemented prior the onset of the second drought since the System filled in 1967. But significant basin polarization over recreation verses navigation continually delays significant progress. Also, lack of agreement on endangered species operations has delayed the implementation of a new plan. The long study of the various purposes and their value to the nation in terms of NED benefits based on value functions has resulted in a different regulation approach during this second drought. Following the current plan and using water accounting as earlier mentioned to focus the plan on the original water conservation have resulted in a similar result to that of the last drought without significant shortening of season length to date as indicated in Figure 8. The quick recovery of the late-1980's drought did not result in a good demonstration of the delayed water conservation approach originally envisioned. Significant season shortening would have

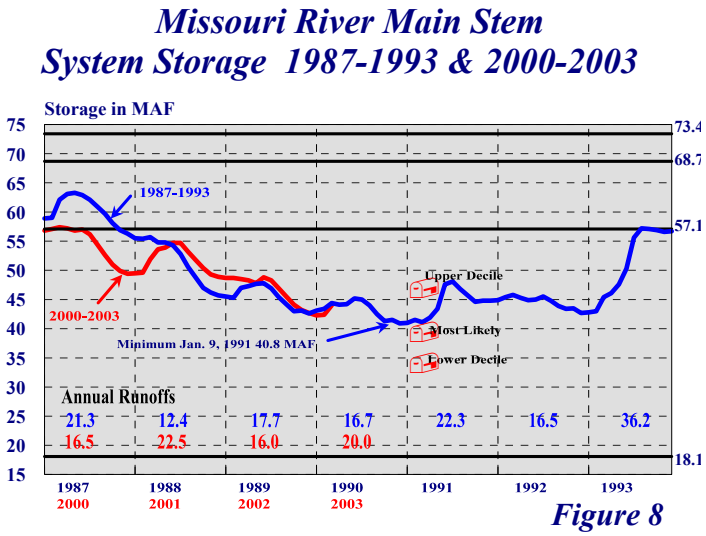


Figure 8

occurred had the drought persisted longer like the 1930's drought. Also a return to normal conditions would have been delayed with a series of lower runoff years.

System Significant Criteria during 2000-Present Drought

Year	Calendar Year Runoff-MAF	15 March Storage MAF	Level of Service Kcfs	1 July Storage MAF	Level of Service Kcfs	1 Sept Storage MAF	Winter Release Kcfs	LengthNav Season Months
2000	16.5	57.7	full	57.0	-1.5	54.3	14	8.0
2001	22.5	50.3	-3.0	54.7	-3.0	53.2	14	8.0
2002	16.1	48.6	-4.0	48.8	-6.0	46.9	13	8.0
2003	20.0*	42.6	-6.0					7.8*

* Estimate based on current forecast

2000 - The 1 July System water-in-storage check of 57.0 MAF resulted in a reduction in the downstream service level by 1,500 cfs with a normal season length. The current Master Manual criteria calls for water conservation to begin when System storage falls below 59 MAF on 1 July. Winter release reduced as a water conservation measure.

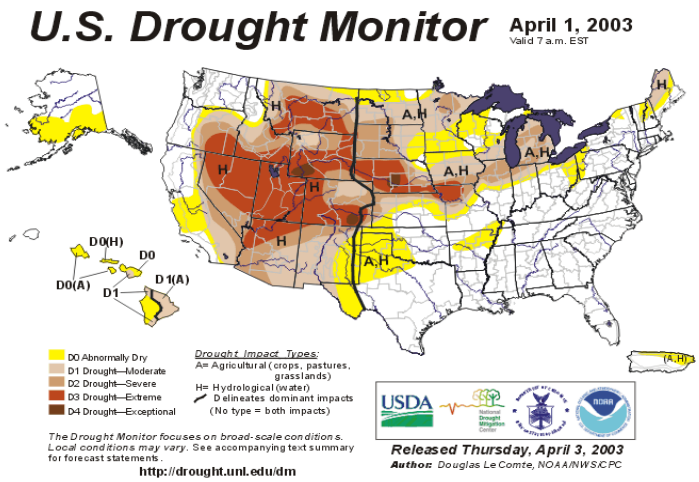
2001-The downstream flow support season began on the normal opening dates. The service level was reduced to 3,000 cfs less than full service to begin the 2001 navigation season. The 1 July water-in-storage check resulted in a continuation of the service level at a rate of 3,000 cfs less than full service (based on current Master Manual criteria). No release increase was made in May for endangered bird nesting. It was determined that adequate nesting habitat still existed (extra habitat was created from the 1997 runoff event which had extended System flows in the 60,000 to 70,000 cfs range) to follow downstream System flow support targets as conditions warranted during the summer. Because the base tributary flows were expected to remain high and vegetation of endangered species habitat had not been determined to be severe, a "follow target" System release was planned and carried out. This conserved a great deal of water. Unfortunately not all the volume contained in the plains snowpack could be utilized as it came off at rates greater than that required to meet downstream target flows. The runoff during 2001 was influenced primarily by a large plains snowpack in the eastern Dakotas that resulted in System releases being very low through May. Winter release was reduced as an additional water conservation measure.

2002-The season began on service level of 4,000 cfs less than full service based on 15 March water-in-storage check. The season was affected beginning in May by a series of State lawsuits initiated by State of South Dakota to maintain a level or rising Oahe pool for smelt spawn. The System downstream flow support was maintained but, over the course of a 4-week period, all five other System reservoirs fell as a result of the litigation. Upstream fish spawn and lake access at all five pools were negatively impacted. The 1 July System water-in-storage check resulted in providing minimum service, 6,000 cfs less than full service. The Corps was again in the 2002 endangered species nesting season operating under a "follow target" plan with System release rather than a "steady release" plan that had been used in the previous drought. This was discussed in AOP meetings in the fall and spring. The first week in July required an increase in System release even

though the service level dropped by 2,000 cfs based on the 1 July System water-in-storage check. The Corps, under the "follow target" operation must move or pick up endangered species nests, eggs and fledglings when they are inundated under the "follow target" type of operation prior to increasing releases. The collection of eggs and their transfer to the Captive Rearing Facility was started and the US Fish & Wildlife Service then informed the Corps that this operation would be considered an illegal "take". Therefore, from 1 July through 15 August releases could not be increased above 25,500 cfs. This resulted in serious problems downstream. There were barge and tow groundings, with one barge broken open, the navigation channel essentially was closed and all tows left the river. Later, dredging was required to open two areas of the channel that experienced serious shoaling due to the low-flow period. Releases were as much as 7,000 cfs below target during the period and channel depths in some locations less than 7 feet. After 15 August System releases were increased and the fall proceeded with a "follow target" plan. Also effluent temperature limits for powerplants were exceeded or limitations placed on some plants because of the low amount of flow in the Missouri river. The navigation season closed on the normal closing dates.

2003-The season started on the normal opening dates at a downstream support service level at minimum service. The season length will be 6 days short based on water accounting for extra water used for winter downstream release support. The season would have been shortened 12 additional days based on winter flows but there was a positive offset taken due to the Corps inability to provide adequate minimum flows during the 6-week summer period in 2002. This water was credited to the 2003 season since it could not be effectively provided in 2002. The current CY runoff forecast is for 20 MAF (80%) of normal. The downstream tributary flow is so low that dredging will once again be required. There are no flow targets below Kansas City and the most affected area is in the Kansas City to the mouth reach where several groundings have occurred. The delay in getting spring fertilizer moved upstream to the farmers has prompted great concern and resulted in emergency dredging on the Missouri River.

SUMMARY- Operations during the current drought are following current manual criteria while striving to meet all the operational objectives stated in the manual**.** Current conditions as shown in the Drought Monitor Map for 1 April 2003 indicate a continuation of the drought. Reservoir levels could reach record lows at the large three upstream projects this summer and, therefore, funding for boat ramp extensions will be provided. Lawsuits and controversy surround the current regulation, which is



focused on implementing the current plan with some deviations for Endangered Species Act compliance and higher winter System releases for water supply which are adjusted for by using the water accounting procedure previously mentioned. One of the more interesting purpose conflicts would have occurred if Federal Irrigation had developed as envisioned. Then the recreation purpose in upstream lakes would have had to suffer more extreme reservoir drawdowns because Irrigation is a consumptive use, which has a higher priority like water supply. The current authorized purpose status promotes a polarization of the basin between upstream and downstream, which makes compromise on any updated water control plan very difficult if not impossible. All plans studied to date for the Master Manual update provide for additional water conservation early in a drought. Even so, because the water in the Carry Over Storage Zone is to be used during dry years, after a period of time the reservoir levels would still be very low, therefore, no magic solution exists. This results in drought periods providing the most significant challenges with regard to System regulation in the Missouri River Basin.